Exam for the course Astronomy from Space on Thursday 14 December 2017 at 10:00 - 13:00 in room HL414

1. The Next two space missions that are dedicated to exoplanets are called TESS and CHEOPS.
   a) Describe these two missions in detail,
   b) who is launching them?
   c) what are (individually and commonly) their purposes?
   d) What are the expected results from TESS?
   e) What are the expected result from CHEOPS?

2. a) Who was Robert H. Goddard?
   b) Why is he so famous in space research that NASA has named one of their major institutes after him?
   c) What was wrong with the New York Times criticism of Goddards work in 1920?
   d) Why did it take until 20 July 1969 until NYT published retraction?

3. Why observe from space? Give different reasons why you would want to go to space.

4. What are the alternatives to go fully into space? Why would you not want to go to space? Give a number of alternatives to deploy your instrumentations on e.g. a satellite or other types of space craft(s/c).

5. Give the 4 different phases of a space project

6. Kepler's laws are fundamental to a proper understanding of any planets movement – those in the solar system or those in other exo-systems

   a) Give Kepler's laws and state the natural law behind each?

   b) What are the possible Keplerian orbits? Are they to be considered in exoplanetology today?

   c) Which of Kepler's laws is most important in interpreting exoplanetary data?

   d) State the law (in c).

7. While there are many methods to detect planets orbiting stars other than the Sun – exoplanets – there are two methods that have been most important in finding the more than 4000 candidates we have today. These are the radial velocity method and the transit method.

   Describe both of these methods!

8. State the most important equations (one each) responsible for the interpretation of:

   a) Exoplanetary radial velocity observations

   b) A light curve with exoplanetary transits

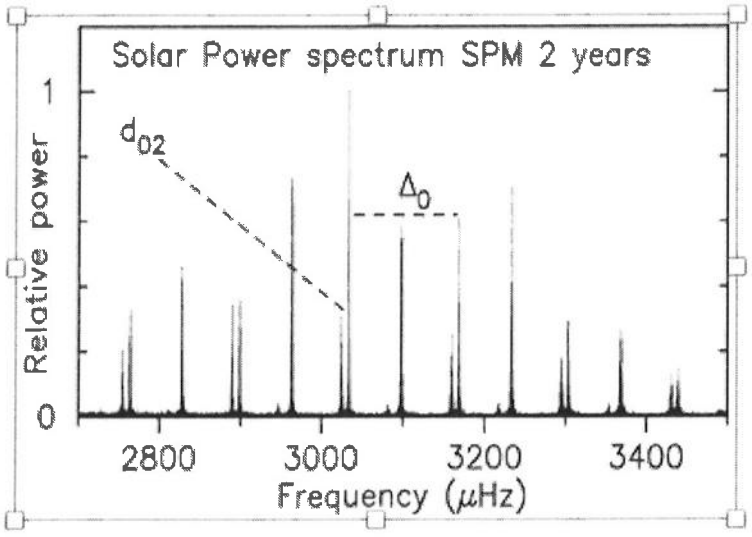
9. A number of assumptions have to be made in order to interpret planetary transit data.

   a) Give the assumptions?

   b) Which parameters for the star/exoplanet system can be derived from the transit light curve?

   c) What is the mass-radius relation of stars?

   d) Why does the exoplanetologist need to know the parameters of the host star?



10. Above you have answered the question about why the exoplanetologist need to know the stellar parameters. In order to get them with the required precision astronomers have come to realize that they require the new technique of asteroseismology.

a) What is asteroseismology?

b) What are p-modes? What are g-modes? Which are required for exoplanetology?

c) In the frequency spectrum of the light curve of a star one recognizes patterns that repeat. These represent different orders of the modes. Two parameters can be seen in the solar frequency spectrum above: $\Delta\nu_0$ and d_{02} These are called the "large separation" and the small separation" respectively. Each one of these can provide a physical parameter: Which ones are they?

11. Asteroseismology depends in practice on two scaling relations where the measured frequencies of a target star can be compared to the observed parameters of our Sun. These scaling relations are also valid for solar type stars after they have left the main sequence (result obtained by the CoRoT and Kepler space missions).
a) Give the scaling relations!
b) Why do we absolutely need to go to space in order to carry out such asteroseismology?

12. The next major space mission dedicated to exoplanets is the European (ESA) PLATO mission:

a) What is the scientific case of PLATO?

b) B) Describe the PLATO spacecraft in some detail. What is the fundamental thoughts about PLATO? What are the scientific requirements?

c) How have the engineers solved the transfer of scientific requirements to technical requirements?

d) Why must the PLATO observations be carried out from space?